ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF EMERGENCY MEDICINE

ASSESSMENT OF FACTORS AFFECTING INTENSIVE CARE UNIT ADMISSION OF CRITICALLY ILL PATIENTS FROM THE ADULT EMERGENCY DEPARTMENT IN TIKUR ANBESA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA.

BY: HELEN TEKLIE (BSc, MSc Candidate)

A THESIS SUBMITTED TO THE DEPARTMENT OF EMERGENCY MEDICINE, COLLEGE OF HEALTH SCIENCES, ADDISS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN EMERGENCY MEDICINE AND CRITICAL CARE NURSING.

JUNE, 2020

ADDIS ABABA, ETHIOPIA

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BY: Helen Teklie (BSc, MSc Candidate)

ADVISORS: Dr. Hywet Engida (Assistant professor of Emergency Medicine and Critical Care)

Mr. Birhanu Melaku (BSc, MSC in EMCCN)

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MASTER OF SCIENCE RESEARCH THESIS SUBMISSION FORM

Name of Investigator	Helen Teklie Tesfahun (BSc)
Name of Advisors	Dr. Hywet Engida (Assistant professor of Emergency Medicine and Critical Care) Mr. Birhanu Melaku (BSc, MSC in EMCCN)
Full title of the research project	Assessment of Factors affecting intensive care unit admission of critically ill patients from the adult emergency department in Tikur Anbesa specialized hospital, Addis Ababa, Ethiopia.
Duration of project	From Oct 2019 –June 2020
Study Area	Addis Ababa, Ethiopia.
Source of fund	Addis Ababa University
Total Cost of the project	30,877.00 ETB
Address of investigator	Mobile phone: +251924436126 Email:helutekle8@gmail.com

Approval by the board of examination

This thesis by Helen Teklie is accepted in its present form by the board of examiners as satisfying the thesis requirement for the degree of master in emergency medicine and critical care.

EXTERNAL EXAMINER:

_____ _____ _____

NAME SIGNATURE DATE

INTERNAL EXAMINER:

_____ _____ _____

NAME SIGNATURE DATE

RESEARCH ADVISORS:

Dr. Hywet Engida (Assistant professor of Emergency Medicine and Critical Care)

_____ _____

SIGNATURE DATE

Mr. Birhanu Melaku (MSc in EMCCN)

_____ _____

SIGNATURE DATE

DEPARTMENT HEAD:

_____ _____ _____

NAME SIGNATURE DATE

Addis Ababa University, College of Health Sciences
Department of Emergency medicine and critical care
Advisor's Approval Sheet

This is to certify that the thesis prepared by Helen Teklie entitled "Assessment of factors affecting intensive care unit admission of critically ill patients from the adult Emergency department in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, ''submitted in partial fulfillment of the requirements for the Degree of Master of Science in Emergency medicine and Critical care nursing complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

Dr. Hywet Engida _____ _____

Name of Major Advisor Signature Date

Mr. Birhanu Melaku _____ _____

Name of Co advisor Signature Date

Declaration

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other university and all sources used for this thesis have been duly acknowledged.

Name: Helen Teklie (BSc)

Signature: _____

Date: _____

ACKNOWLEDGMENTS

First and foremost, I would like to thank God for being with me from the beginning to the completion of this study.

My deepest gratitude goes to my advisors, Dr. Hywet Engida and Mr. Birhanu Melaku for their unreserved professional support, technical guidance, advices and uninterrupted emotional support to deal with the possible hardships throughout the process of the research proposal development up to the development of the whole thesis.

I would like also to thank Addis Ababa University, College of Health Sciences, Department of Emergency Medicine and all the staff of the department for their technical and administrative support. I would also like to recognize AaBET hospital for offering me such a rewarding educational opportunity.

Finally, I extend my thanks to my family and colleagues for their emotional support and encouragement.

ACRONYMS

AaBET: Addis Ababa Burn, Emergency and Trauma Hospital

AAU: Addis Ababa University

CHS: College of Health Sciences

ED: Emergency Department

EDLOS: Emergency Department Length of Stay

EMCCN: Emergency Medicine and Critical Care Nursing

G.C: Gregorian calendar

GCS: Glasgow coma scale

ICU: Intensive care unit

LAMA: Leave against Medical Advice

LOS: Length of stay

NEWS: National Early Warning Score

SOCCM: Society of critical care medicine

SPSS: Statistical Package for Social Sciences

TASH: Tikur Anbesa Specialized hospital

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ABSTRACT

Background: Critically ill patients are commonly present to the emergency department (ED) and need early care to improve outcomes. The transfer time for critically ill patients from the ED to the Intensive care unit (ICU) must be minimal; however, some factors prolong the transfer time, which may delay intensive care treatment and adversely affect the patient's outcome.

Objective: to assess factors affecting intensive care unit admission of critically ill patients from the adult emergency department in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia.

Methodology: A cross sectional study design was conducted from January to June2020at the emergency department of Tikur Anbesa Specialized Hospital. All critically ill patients who need intensive care unit admission during the study period were included in the study. The data were collected by chart review and observation. EpiData manager Version.4.6.0.2 and SPSS Version.23 for windows was used for data entry and analysis, respectively. Descriptive statistics and bivariate and multivariate logistic regression were used to analyze the data.

Result: From the total of 102 critically ill patients who need ICU admission 84.3% stayed more than 6 hours in the ED and majority of critically ill patients 26.5% had acute respiratory failure that requires ventilator support. The median length of stay was 13.5 hours with an IQR of 7-25.5 hours. Shortage of ICU beds 56 (59.2 %) and delays in radiological examination results 13 (12.7%) were found to be the most important factors that delay ICU admission. On bivariate logistic regression $p<0.05$male gender (AOR = 0.175, 95% CI: (0.044, 0.693)) and shortage of ICU bed (AOR= 0.022, 95% CI: (0.002, 0.201)) were found to have a significant association with delayed intensive care unit admission.

Conclusion: the study found that there was a delay in ICU admission of critically ill patients from the ED. Shortage of ICU bed, delay in radiological investigation result and other organizational factors were among the reasons for the prolonged ED stay.

Keywords: Emergency department, Critically ill patients, ICU admission

1. INTRODUCTION

1.1. Background

An emergency department (ED) is a hospital unit responsible for managing and stabilizing sick patients in need of immediate care, followed by a transfer to the appropriate health care provider, but when patients are critically ill and require intensive care and monitoring they must be admitted to the intensive care unit (1).

Intensive care unit (ICU) is a special department of a hospital that is outfitted with advanced innovations, for example, life support equipment that is used to assist or replace spontaneous breathing and trained professionals to provide intensive and advanced life-supportive care of critically ill patients (2,3). ICU offers care for patients with a critical condition like, acute organ failure or, those who need immediate monitoring to prevent and identify acute organ dysfunction and those who need an end of life care (4,5).

The transfer time of critically ill patients from the ED to the ICU must be short, according to the recommendations of the Society of Critical Care Medicine (SOCCM). The guideline recommends that the emergency medicine practitioners should be ready to provide critical care in the ED, considering the frequent absence of ICU bed availability. However, studies indicate that patients who meet the ICU admission criteria and treated in the ICU had a higher survival rate than those treated out of the ICU (2).

In several hospitals, most ICU admissions are through the emergency department (ED). From patients who visit the emergency department 22-30% need hospital admission (6,7) and from that 1% will use intensive care unit (8). These critically ill patients are usually present in the ED and need early and aggressive care in order to improve results. In addition to this life-saving intervention in the ED, patients with severe illnesses are admitted to the hospital and proceed the treatment with in a specialist department (9–11).

It is important to recognize critical illness early to enable the prompt referral of patients who may benefit from the intensive care. Published data in the UK shows that the duration of hospitalization before ICU admission is an independent predictor of ICU outcome (12).

However, studies show that critical care in Africa remains a neglected field of health service provision, with large numbers of patients with potentially treatable conditions unable to receive these facilities. In Ethiopia limited studies also show that critically ill patients spend prolonged time in the ED and they had poor out come due to limited critical care services (13,14).

Overcrowding in the ED has been a worldwide issue. It is becoming more common in Ethiopia and affects the quality of care, Due to the problem of overcrowded Eds, critically ill patients consume a relatively high capacity of ED leading to a reduced ED capacity to deal with new arrivals. If critically ill patients have to stay in the ED as a result of insufficient ICU beds, ED crowdedness would worsen (15,16).

In addition to this overcrowding, delays in the ED have some significant consequences, including reduction of giving care on time, extended hospital stays, failure to gain access to hospital beds, inability to accept new patients for temporary relief over the crowd, and patients left without being seen (17).

1.2.Statement of the problem

A delayed admission from emergency department to intensive care unit increases the ED burden. Furthermore, studies showed that critically ill patients who spend longer time in the ED have higher mortality rate than those who were admitted early.

In numerous developing countries, the capability of intensive care (ICU) is limited. There are between 5 and 30 intensive care unit beds per 100,000 people in high-income countries, but there are only0.1and 2.5 ICU beds per 100,000 people in developing countries (18).

The volume of critically ill patients who transferred from ICU to ED has increased significantly by almost 50 % in United States and they are treated in the ED for a long time, despite requiring admission to an intensive care unit. Ideally critically ill patients, who need an acute intervention, should be transferred to the ICU immediately in order to receive the best appropriate care. Prolonged waiting time for transfer from the emergency department to ICU may delay intensive care treatment. Delayed intensive care unit admission is a known aggravating factor of poor outcome in the critically ill patients(19).

In Finland, studies revealed that the delay of transfer from ED to ICU was due to therapeutic and diagnostic procedures, which are performed in the ED. A patient who came with communication and a low consciousness level was admitted to the ICU earlier than others (20). Delays in transferring patients from the ED to the ICU can have a negative impact on patient outcomes, including increased hospital mortality and ICU length of stay as well as increased mechanical ventilation requirement during ICU stay (20,21).

In Pakistan, a critically ill patient stayed in the ED for more than 6 hours has 27.3% hospital mortality, compared to those who have got early transferred to ICU with 20.7% of hospital mortality. It was also indicated that ED mortality is high as the time of ED stay become longer and more than 24 hours length of stay (LOS) in the ED has 36.4% ED mortality rate. The finding also revealed that ordering several radiological tests and performing interventional procedures in the ED were the main reason for delaying the transfer of a patient (22).

Unavailability of ICU beds, increased number of critically ill patients, and shortage of intensivist physicians has strained the potential of ICUs in many health care systems. This combination of

factors has made an extra demand to provide prolonged critical care in the emergency department (23).

Research in Ethiopia indicated that, 67.5% of critically ill patients have more than 6 hours LOS and 32.3% of this died before transferring to the ICU. The study revealed that lack of critical care beds, delay in radiology and laboratory test services and limited resources were the common reasons which predisposed patients to prolonged emergency department stay (14,16).

Early Intensive Care Unit admission has gained a higher profile ever since the development of published guidelines. However, delayed ICU admission from the ED like a long stay of the critically ill patients in the ED and giving intensive care in the ED were observed by the investigator in workplace. Thus, the investigator aims to identify the factors that delay intensive care unit admission from the ED at TASH, Addis Ababa, Ethiopia. To the best of investigators' knowledge, there are only few studies regarding the factors that delay intensive care unit admission from the ED in Ethiopia, which is directly related to poor outcome. Specifically, this study aimed to answer the question: what are the factors that delay ICU admission of critically ill patients from the ED at TASH, Addis Ababa, Ethiopia?

1.3. Significance of the study

Understanding the reasons behind longer hour stay of critically ill patients in the emergency department is essential for better planning of resources required to respond to the more prevalent emergency medical conditions presenting to the ED. Evaluation of Emergency Department service for critically ill patients and their time of admission to the intensive care unit are also required to indicate the level of quality of health care given.

The findings of the study may provide an in-depth understanding of the factors that delay intensive care unit admission from the emergency department for responsible bodies and hospital managers which could help to improve the service.

The information generated through this evaluation may be used to improve the quality of critical care service, the outcome of critical patients, to decrease emergency department overcrowding, emergency department medical service arrangement and readiness. The gaps between the critically ill patient's need and the service are also identified in this study. Overall, the findings have important suggestions for policy and decision making in health care planning and in allocating resources and also it can be used as an input to researchers for further study.

2. LITERATURE REVIEW

Several studies have confirmed that there has been a steady increase in critically ill patients. These critically ill patients commonly present in the emergency department and require aggressive resuscitation. Critically ill patients who present in the ED and need admission to the intensive care unit must transfer early to the ICU, but studies show that due to factors like; therapeutic and diagnostic procedures, shortage of intensive care unit beds and delay in investigations, patients spend a long time in the emergency department (19,20).

2.1. Critically ill patients Emergency Department Length of Stay

A retrospective study conducted in the Province of Ontario, Canada; from April 2007 to March 2012 showed that 261,274 adults visited 118 EDs in Ontario, from those 314,836 were admitted to the ICU. The median EDLOS for all ICU admissions from the ED was 7, inter quartile range of 4–13hours. Of the ICU admissions, 10.5% stayed in the ED for 24 hours or longer. Therefore, less than half of these ICU admissions had an EDLOS of 6 hours or less as currently recommended by the Canadian Association of Emergency Physicians, a universally accepted performance indicator used to assess the quality of emergency care. In the study, patients who are on mechanical ventilator had shorter EDLOS than those non-ventilated patients. Most of the ICU admissions were primarily related to cardiac conditions (24).

In Northern Finland, Oulu University Hospital, there were 26,479 admitted patients in the ED, from those 500 (1.9%) were transferred to the ICU. After excluding patients who did not have adequate information in patient records, the final number of patients transferred from ED to ICU was 479 (1.8%) between May 2016 to March 2017. A patient's ED length of stay (LOS) above 180 minutes was considered delayed. In the study most of the patients (380, 79.3%) were transferred to the ICU within 3 hours of hospital admission, 55 patients (11.5%) waited over 4 hours and 26 (5.4%) over 6 hours. The median ED LOS was 92 (60-162) minutes. The study also revealed that trauma is the leading reason and neurological condition is the second common diagnosis for ICU admission (20).

In China, Hangzhou, Sir Run Run Shaw Hospital, patients with sepsis who need admission from the ED to the ICU spent long time in the emergency department. The study included patients with a diagnosis of sepsis transferred to the ICU from ED from January 2010 to April 2018.

There were a total of 1997 patients, including 473 non-survivors and 1524 survivors. The number of critically ill patients spent < 6 hours in the ED were 1306 (65.4%) which was significantly higher than patients with EDLOS > 6 hours 691 (34.6%). It showed that most patients were transferred to the intensive care unit within 6 hours (25).

A study done at Aga Khan University Hospital, Pakistan (2010) showed that of the 49,532 patients visiting the ED during the study period, 17,968 (36.3%) were admitted. Of them, 2356 (13%) were transferred to the ICU and 1595 (67.7%) of this subgroup waited in the ED for > 6 hours before admission. In this study, six hours were selected as the standard for admission from the ED to ICU based on literature. By using the sampling technique, the study randomly picked 325 (0.65%) of the total patients; 164 (50.5%) in the non-delayed group and the delayed group was 161 (49.5%). Critically ill patients (49.5%) spent longer than 6 hours (mean 12.9±7.4) to be transferred to ICU. The median EDLOS for critically ill patients before admitted to ICU for the study period was 10.5 hours. In the study, cardiovascular condition was the most common admission diagnosis for ICU but they were transferred earlier than others and patients with cerebrovascular accident are spent long time in the ED (22).

Similarly, study conducted in both Tikur Anbesa Specialized Hospital (TASH) and St. Paul's Hospital Millennium Medical College in Addis Ababa, Ethiopia from September to 2016 showed that there were 7661 patients admitted to the emergency department during the study period. Of these patients, 3959 were classified as medical patients, 2531 as trauma patients and 1171 as other surgical patients. During the study period, a total of 431 patients were admitted to the intensive care unit in both hospitals and neurological disease was the primary reason for ICU admission. Of those 291 (67.5%) critically ill patients had a prolonged stay of more than six hours. The length of stay ranged from 6 to 240 h. The median length of stay was 48 h, interquartile range (IQR) of 25–72 h, and a mean length of stay was 53 h, with a standard deviation (SD) of 38.5 (14).

2.2. Factors that delay ICU admission from ED

A study conducted in the Province of Ontario, Canada revealed that, ED crowding is strongly associated with prolonged EDLOS. The study showed potential reasons for the delay of ICU admission was hospital bed management policy, such as, holding admission until shift changes,

delay for diagnostic test result, or specialist consultation. The study also revealed that, patients with co-morbidities and increased age had an association with prolonged EDLOS (24).

In Northern Finland, Oulu University Hospital, most critical patients had not stayed long hours in the ED before transferring to the ICU, but for those who spent more than three hours; x-ray examination and diagnostic test (blood culture) were performed in 47.5% and 43.4% respectively, which is higher than those who transfer early 25.5% and 23.2% respectively. The study revealed that therapeutic procedures, diagnostic procedures, and diagnostic groups were the main reasons for delays for patients to transfer from the ED to the ICU (20).

According to a study done at Aga Khan University Hospital, Pakistan (2010), 49.5% critically ill patients are in delayed group, from that 82% of the patient have an x-ray examination and 14.4% has an ED intervention, but from the non-delayed group, 74% patients has an x-ray examination and 4.4% has an ED intervention, which shows that procedures that are done in the ED and radiological interventions are the main cause for the patients to spend more time in the emergency department (22).

Study finding from China showed that one of the reasons for the delay of ICU admission was time the ICU consultant physician took for seeing the patient and approving the admission. Both studies conducted in China and Ethiopia, showed that there were limited critical care resources. The studies indicated that prolonged stay was greatly associated with lack of ICU bed and it potentially reduced clinical outcomes and placing a significant load on ED resources (14,25).

2.3.Conceptual framework

The conceptual framework used here is based on the above literature review. It shows three factors that have relation to delayed ICU admission from the ED. These are organizational factors, patient factors and socio demographic factors.

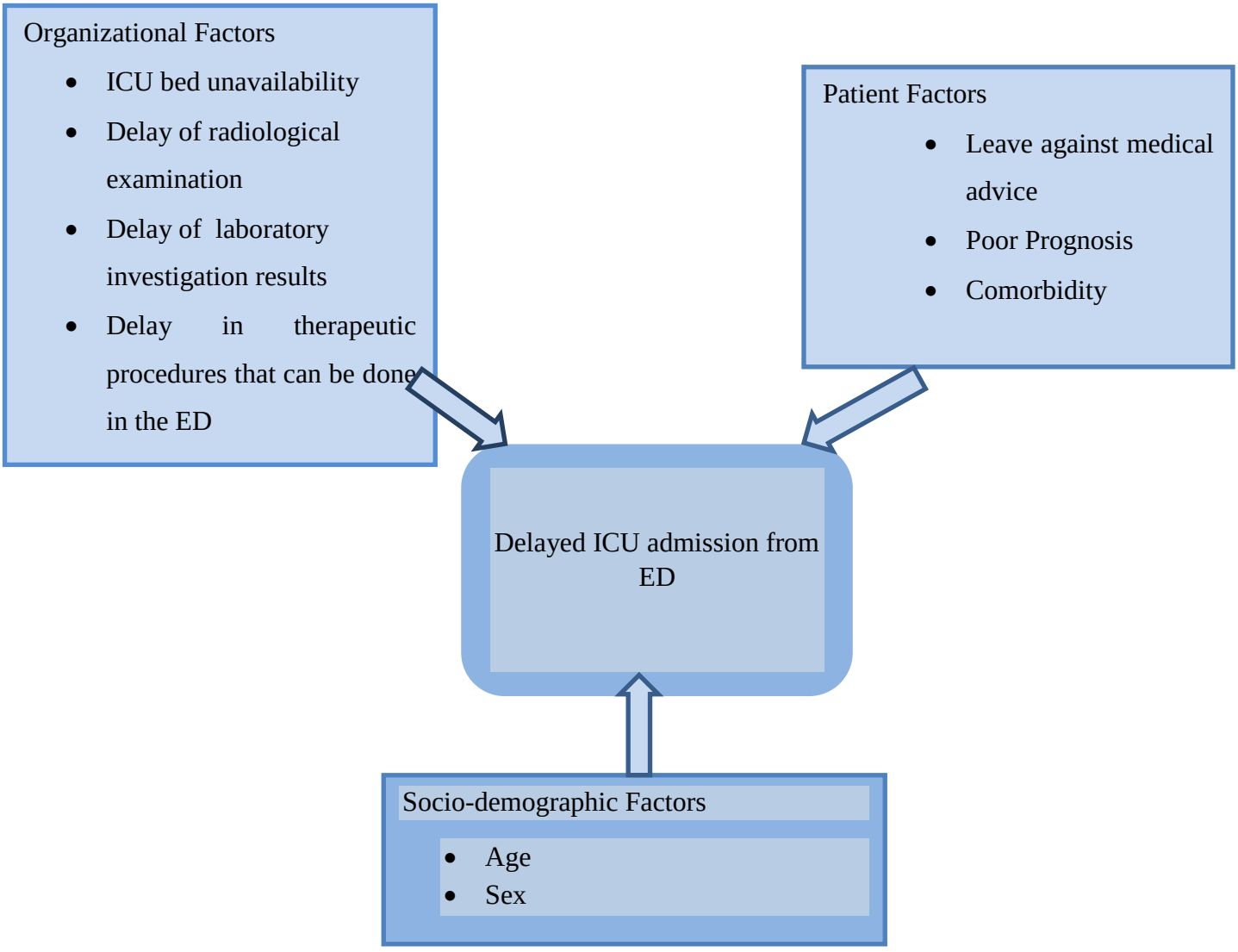

Figure1. Conceptual framework which reflects the relationship between associated factors and delayed ICU admission from the ED.

3. OBJECTIVES

3.1.General objective

- The general objective of this study was to assess factors affecting intensive care unit admission of critically ill patients from the adult emergency department at TASH, Addis Ababa, Ethiopia, from January to June 2020.

3.2.Specific objectives

- To assess the median length of stay of critically ill patients in the ED who require ICU admission
- To assess the diagnosis of critically ill patients who require ICU admission
- To identify factors that delay intensive care unit admission

4. METHODOLOGY

4.1.Study area

Addis Ababa is the capital city of Ethiopia. According to the 2007 census, it has an estimated population of 3,384,569 people in an area of 540 Square Kilometers. The city comprises of 10 sub-cities and 116 woredas. People from different regions of Ethiopia populate the city.

Tikur Anbesa specialized hospital is Ethiopia's largest tertiary public hospital and sees approximately 370,000-400,000patients a year but the exact number is not known. The hospital has 800 beds. The emergency department sees around 18,000 patient visits per year, which provides 24 hours of emergency services. On average, 50 traumatized and/or critically ill patients are seen in the ED per day and many require emergency care or resuscitation. The emergency department has a total of 56 beds, but the RED Zone, where critically ill patients are admitted has only 7 beds. The hospital has four intensive care unit department. These are surgical ICU, medical ICU, mixed for surgical and medical patients ICU and pediatric ICU. Each unit has 4 beds with a total of 16 beds (26).

4.2.Study period

The study was conducted at the adult emergency department of Tikur Anbesa Specialized Hospital in Addis Ababa, from January13 to April 12, 2020.

4.3.Study design

An institutional based cross-sectional study design was applied.

4.4.Population

4.4.1. Source population

The source population of the study was all patients visit adult ED of Tikur Anbesa specialized hospital, Addis Ababa.

4.4.2. Study population

The study population was all critically ill patients who were admitted to the adult emergency department and needs intensive care unit admission during the data collection period in TASH.

4.5.Eligibility criteria

4.5.1. Inclusion criteria

All critically ill patients who consult for ICU admission in the adult ED were eligible for inclusion in the study.

4.5.2. Exclusion criteria

A patient chart which has inadequate information was excluded.

4.6.Sampling technique

Due to a smaller number of the study population, convenience sampling method was used to obtain the study population.

4.7.Sample size determination

All critically ill adult patients who were admitted to the ED, and need intensive care unit admission during the data collection period was included and the data collectors observed the admission process until the patient left the ED.

4.8.Measurement Variables

4.8.1. Dependent variable

- The dependent variable in the study was delayed ICU admission of critically ill patients who are eligible for ICU admission in the ED.

4.8.2. Independent variables

Socio-demographic factors

- Age
- Sex

Patient Related factors

- Leave against medical advice
- Poor prognosis
- Patient comorbidity

Organizational Factors

- ICU bed unavailability
- Delay in Radiological examination
- Delay in laboratory investigation result

- Delay in therapeutic procedures that can be done in the ED

4.9.Data collection procedures:

The sources of data for the study were the medical record charts of critically ill patients who wait for intensive care unit admission. A structured questionnaire and observation were used to collect data until the patient left the ED. The questionnaires were adapted from up-to-date literatures(14,20,22,24,25).

The questionnaires includes information regarding patient demographics, time of arrival to the ED, time of decision for ICU admission, working diagnosis, procedures performed and time of patient disposition. Data was collected by emergency and critical care nurses working in the study hospital.

4.10. Data Quality Assurance

Data collectors were trained for one day to collect the data throughout the data collection period. The questionnaires filled upon ED admission of critically ill patients who need ICU admission and completed during disposition with documentation of time of disposition. From the government hospital, AaBET hospital was selected by a simple lottery method and used as a pretest study area for two weeks and the necessary corrections were made to the research questionnaires so that it would be specific, reliable and valid enough to answer the questions and meet the objectives. The Principal investigator supervises the quality of data by collecting the questionnaires frequently and by reviewing the completeness of data. Each questionnaire was checked for completeness, missed values and unlikely responses, those incomplete questionnaires were omitted from the analysis.

4.11.Data entry and analysis

All questionnaires were checked for completeness. The data were entered through EpiData manager version 4.6.0.2 epidemiological software package for editing, cleaning, coding and checking the completeness and consistency and analysis was done by using SPSS version 23 for windows. The generated data were displayed by frequency tables, graphs and proportions. Bivariate logistic regression was used to estimate the crude odds ratio of all independent variables on factors that delayed ICU admission with p-value of < 0.25 and multivariate logistic regression was also be used to estimate the adjusted odds ratio of the factors to control

confounders and predict the final predictor at 95% confidence interval and 0.05 level of significance.

4.12.Ethical Consideration

Ethical approval for the study was obtained from the Addis Ababa University, College of Health Sciences, department of Emergency Medicine. A support letter was taken from the Emergency Department to the study hospital for permission to conduct the study. The research purpose, its benefits and the procedures were explained for the Emergency Department staff member and manager. Confidentiality and privacy were strictly maintained. Only the principal investigator and the research assistants can access the data.

4.13.Dissemination of findings

The findings of the study will be presented to the Department of Emergency Medicine and Critical care. It will also be disseminated through presentations at different professional association meetings and annual conferences. In addition, efforts will be exerted to publish the study findings on local/ international journal.

4.14.Operational definitions:

- **Intensive care unit** is a clinical environment that enables close attention to critically ill or injured patients. It allows prompt recognition of physiologic change and sudden deterioration in the patient's condition. Intensive care units are also known as critical care units.
- **Emergency Department** is a department of a hospital, which specializes in emergency medicine and responsible for the treatment / acute care of patients who present without prior appointment, on their own or ambulance.
- **Prolonged ED LOS** is defined as an ED LOS of a critical patient for more than 6 hours, based on a previous study by Khan and Sultan and Society of Critical Care Medicine's guidelines (14,22).
- **Critically ill patients** are patients who are at high risk for actual or potential life-threatening health problems. They have a key feature of severe respiratory, cardiovascular or neurological derangement, often in combination, reflected in abnormal physiological observation and need intensive care and monitoring in the intensive care unit.

- **Delayed intensive care unit admission** is when a critically ill patient spent more than 6 hours in the ED after consulting and decides for ICU admission.
- **Non-Delayed ICU admission** is when a critically ill patient who consulted for ICU admission, transfer to the ICU with less than 6 hours of ED stay.
- **Red Zone** is a critical zone in the emergency department, where critically ill patients are seen immediately and receive resuscitation, ongoing medical care or closer observation within a few minutes of the patient's arrival.
- **Delayed radiological and laboratory investigation result:** is when a critically ill patient's laboratory and radiology investigation result took more time and delay the patient transfer process from the ED to the ICU.
- **Comorbidity:** is when a critically ill patient had additional one or more co-occurring chronic illness with the current problem.
- **NEWS (National Early Warning Score):** is evidence based system of care, used to facilitate timely recognition of patients with established or impending critical illness and allow for timely admission to intensive care, (NEWS $\geq$ 7 high score, NEWS > 5 medium score and NEWS 1-4 low score) (27).

5. RESULT

5.1.Socio-demographic characteristics

A total of **102** critically ill patients who need and consulted for ICU care were observed during the data collection period and their recorded data were collected; more than half of them 61 (59.8%) were males and 41 (40.2%) were females. The mean age of patients was 40.35 years (SD ± 17.7). The finding further revealed that, majority 62 (60.8%) of critically ill patients who need ICU admission were from Addis Ababa, 26 (25.5%) from Oromia region, Southern Nations Nationalities and People (SNNPR) 4 (3.9%), Amhara 6 (5.9%) and the rest 4 (3.9%) were from Tigray and Afar region. Regarding to their source of referral, the majority of critically ill patients 53 (52%) had come from another governmental hospital. (Table 1)

Table 1.Socio-demographic profile of critically ill patients included in this study, from January-April 2020 in TASH, Addis Ababa, Ethiopia.

Variables	Category	Frequency (N=102)	Percent (%)
Age group (years)	<18	8	7.8%
	18-50	59	57.8%
	>50	35	34.3%
Sex	Male	61	59.8%
	Female	41	40.2%
Residence	Addis Ababa	62	60.8%
	Oromia	26	25.5%
	SNNPR	4	3.9%
	Amhara	6	5.9%
	Other (Tigray & Afar)	4	3.9%
	Self	34	33.3%

Source of referral	Another governmental hospital	53	52.0%
	Public health center	1	1.0%
	Private health facility	7	6.9%
	Others	7	6.9%

5.2.Baseline information of critically ill patients

The result revealed that, from the total critically ill patients who consulted for ICU admission 10 (9.8%) were trauma patients and the rest 92 (90.2%) were non trauma patients. Majority of 92 (90.2%) the critically ill patients whose consulted for ICU care, were high risk patients with NEWS was ≥7 and the rest (9.8%) had a medium NEWS score > 5.Most patients 75 (73.5%) were also having a known chronic medical illness, whereas 23 (22.5%) had no known chronic medical illness and the rest 4 (3.9%) patients had no record on their medical chart. As shown in the following table from the total critically ill patients, the majority 29 (28.4%) had cardiovascular illness followed by hematological malignancies 21 (20.6%). (Table 2)

Table 2. Past medical history of critically ill patients who need ICU admission in TASH, Addis Ababa, Ethiopia, 2020.

Past Medical Illness	Number (N=102)	Percent (%)
Respiratory	7	6.9%
CNS	4	3.9%
Renal	9	8.8%
Cardiovascular disease	29	28.4%
Gastrointestinal	5	4.9%
Other malignancy	3	2.9%
Endocrine	7	6.9%
Hematological malignancy	21	20.6%
Others	2	2.0%

Key: CNS (Central nervous system) disease, other malignancy (Cervical Cancer, Cholangiocarcinoma), Others (systemic lupus erythematous)

5.3.Management given at ED for critically ill patients

As shown in Table 3, majority of critically ill patients 95 (93.1%) were on ventilator support, from those 28 (27.5%) were on a mechanical ventilator through endotracheal intubation and the rest were on non-invasive ventilation. Most of the patients 87 (85.3%) were started broad spectrum antibiotic and those who was admitted due to shock 34 (33.3%) were on vasopressor in the ED and all patients were on monitoring. (Table 3)

Table 3. Management given at the Emergency Department for critically ill patients from January-April 2020, in TASH, Addis Ababa, Ethiopia.

	Frequency (N)	Percent (%)
Ventilator support	95	93.1%
Endotracheal intubation	28	27.5%
Initiation of broad-spectrum antibiotic	87	85.3%
Initiation of vasopressor	34	33.3%
On monitoring	102	100.0%
CPR	6	5.9%

Key: CPR= Cardiopulmonary Resuscitation

5.4. Critically ill patients Length of Stay at ED

Critically ill patients 86 (84.3%) stayed for more than 6 hours in the ED before transfer to ICU or they had a delayed ICU admission. (Figure 2)

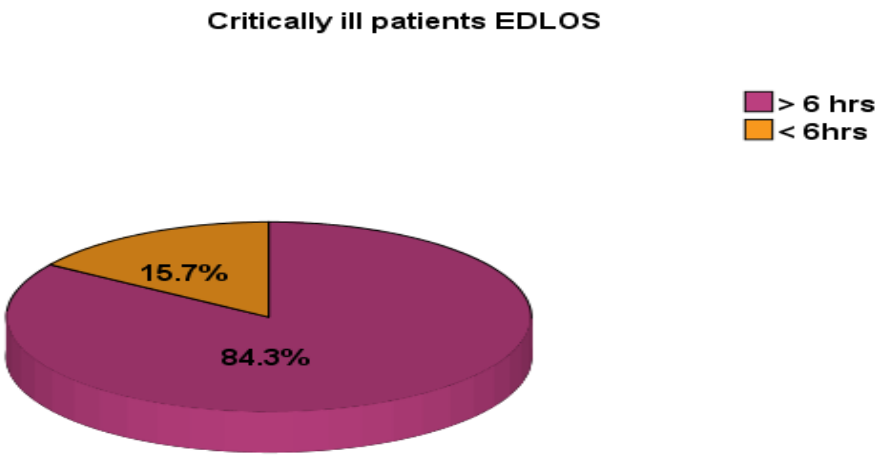

Figure 2. EDLOS of adult critically ill patients from January- April 2020, in TASH.

Of the 102 critically ill patients who need and consulted for critical care 53 (52%) were transferred and 49 (48%) were not transferred to the ICU during the study period. The highest length of stay of critically ill patients in the ED who consulted for ICU admission was 144 hours or 6 days, but most critically ill patients 35 (34.3%) had an emergency department length of stay of 6-12 hours. The length of stay ranged from 1 hour to 144 hours. The median length of stay was 13.5 hours, with an IQR of 7-25.5 hours. (Figure 3)

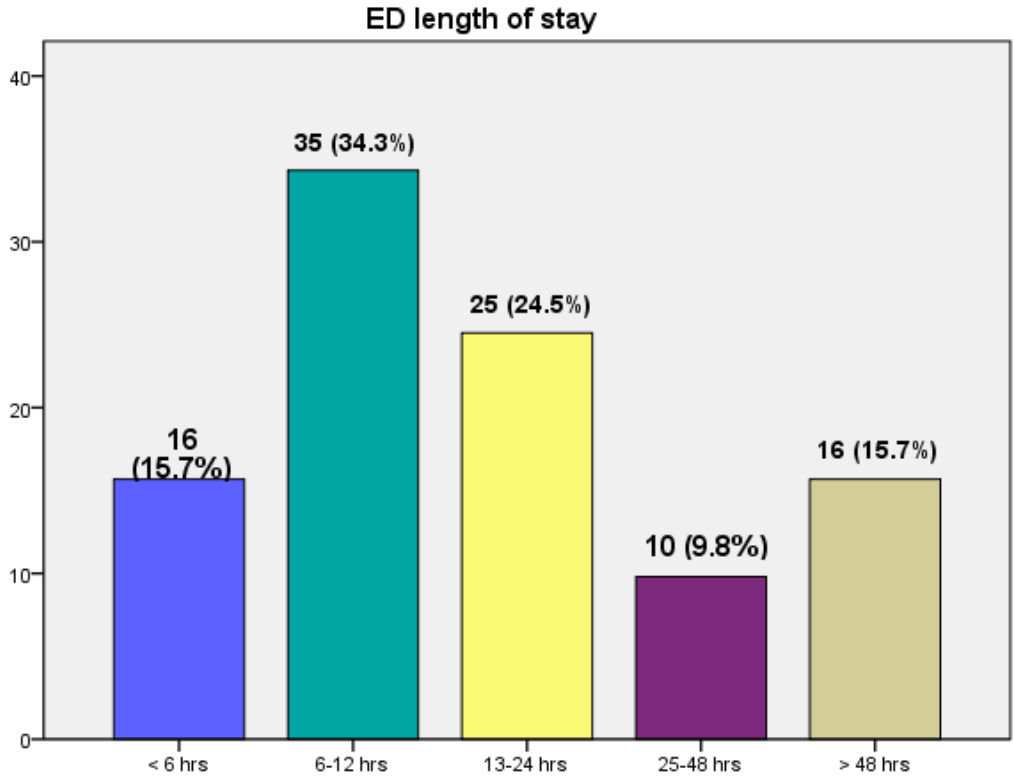

Figure 3.Total length of ED stay of critically ill patients by time group from January-April 2020 at TASH, Addis Ababa, Ethiopia.

5.5.ED diagnosis of critically ill patients who need ICU admission

In this study, majority of critically ill patients (26.5%, N=27) had an acute respiratory failure that requires ventilator support, septic shock (18.6%, N=19), AKI (6.9%, N=7), acute stroke (6.9%, N=7) and CHF with respiratory failure (5.9%, N=6) were among the top 5 causes, which leads the patient a need of an ICU admission (Table 4).

Table 4. Diagnosis of critically ill patients at RED zone who need ICU admission during the study period, in TASH.

Diagnosis	Frequency	Percent (%)
Trauma/poly trauma	3	2.9
Septic shock	19	18.6
Acute respiratory failure requires ventilator support	27	26.5
AKI	7	6.9
Severe head trauma	3	2.9
Acute stroke	7	6.9
UGIB	4	3.9
Other shock states	7	6.9
Acute coronary syndrome	5	4.9
CHF with respiratory failure	6	5.9
GBS	1	1.0
Acute spinal cord injury	1	1.0
Life threatening arrhythmias	3	2.9
ICH	2	2.0
Meningitis	4	3.9
Others	3	2.9
Total	102	100.0

Keys: Other shock states (hypovolemic shock and cardiogenic shock), UGIB (upper gastrointestinal bleeding), AKI (Acute kidney injury), CHF (congestive heart failure), GBS (Guillain Barre Syndrome) and ICH (Intracranial Hemorrhage), (Others: Neutropenic fever and Tetanus)

5.6.Factors that delay ICU admission of critically ill patients

For the reasons that delay ICU admission of critically ill patients who need intensive care, the most common factor 56 (54.9%) was lack of ICU bed and the second most common reason 13 (12.7%)was delay of radiological examination result. Among the total 86 (84.3%) critically ill patients who spend more than 6 hours in the ED, 6 (5.9%) were due to their disease condition or physician decides that they are not benefiting from the admission because they have a poor prognosis.

There are also other reasons which cause delayed ICU admission, 6 (5.9%) was because of the delayed laboratory investigation result, 3 (2.9%) was due to therapeutic procedures that can be done in the ED and 2 (2.0%) because of refusal of treatment. (See Figure 4)

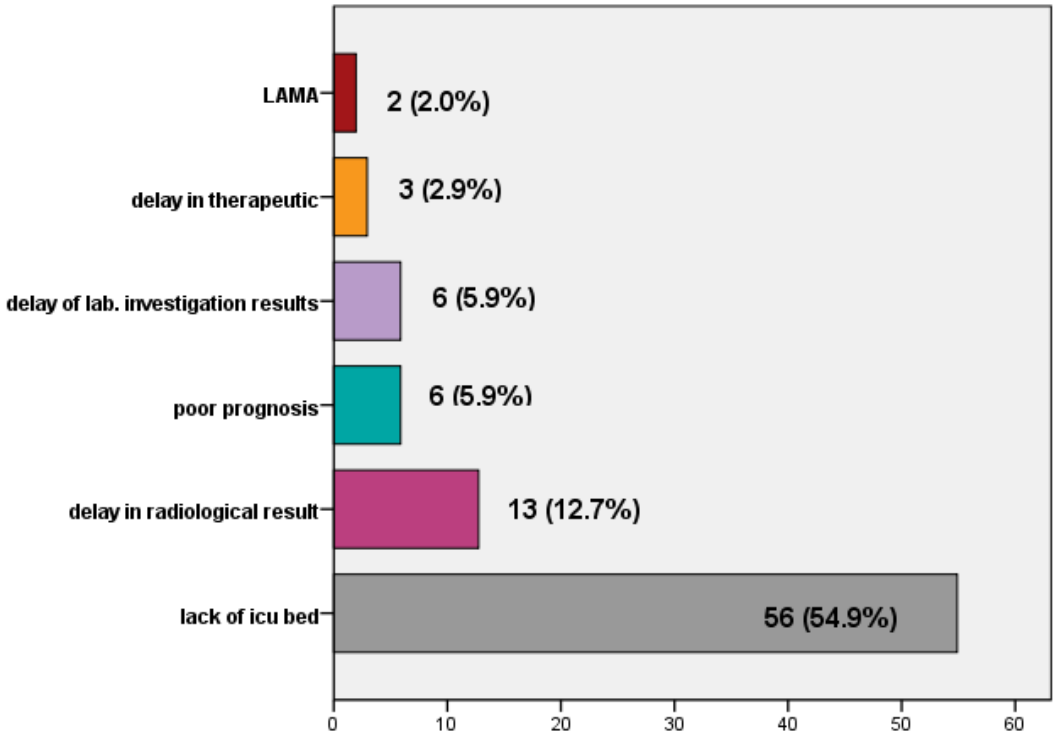

Figure 4.Factors that affect ICU admission of critically ill patients from the adult ED in TASH, Addis Ababa, Ethiopia, 2020.

5.7. Factors associated with delayed ICU admission of critically ill patients

Bivariate and multivariate logistic regression analysis were performed to see the existence of an association between the delayed ICU admission and Socio-demographic characteristics, patient related factors and organizational factors. In bivariate logistic regression analysis, the factors found to be significantly associated with delayed ICU admission with p-value < 0.25 were the lack of ICU bed, sex, having hematological malignancy and cardiovascular disease.

On the other hand, to control the effect of confounding variable, factors with p value<0.25 were entered into multivariate logistic regression and lack of ICU bed and male gender was statistically significant to predict delayed ICU admission in the multivariate logistic regression with p-value of < 0.05.

In a binary logistic, patients who had a history of cardiovascular disease were 2.2 times higher to transfer in the ICU with less than 6 hours than who don't have the disease (COR 2.263 (0.753-6.798)) but patients who had hematology malignancy were less likely to transfer to the ICU with less than 6 hours by 78% than who don't have the disease (COR=.220(0.027, 1.770)).
However, in multivariate regression, only male gender and lack of ICU bed had an association.
Male critically ill patients were less likely to transfer to the ICU within less than 6 hours by 82%than females (AOR = 0.175, 95% CI: (0.044, 0.693)) and when there was lack of ICU bed, transfer to the ICU in less than 6 hours ED stay were less likely by 97% (AOR= 0.022, 95% CI: (0.002, 0.201)). (See Table 5)

Table 5. Bivariate and Multivariate analysis of factors associated with delayed ICU admission of critically ill patients from the adult ED of TASH, Addis Ababa, Ethiopia from January-April 2020.

Variables Category		ICU admission		P-value <0.25	COR (95%C.I) (Lower, upper)	P-value <0.05	AOR (95%C.I) (Lower, Upper)
		< 6hrs	> 6hrs				
Age	<18	2	6	.465	2.00 (.312,12.840)		
	18-50	9	50	.899	1.080 (.331,3.526)		
	>50	5	30		1		
Sex	Male	6	55	.054*	.338 (.112,1.020)	.013**	.175(.044,.693)
	Female	10	31		1		
Lack of ICU bed	Yes	1	55	.002*	.038(.005,.298)	.001**	.022(.002,.201)
	No	15	31		1		
Delay of lab. Inves. Result	Yes	0	6	.999	.000 (.000)		
	No	16	80		1		
Delay in therapeutic procedure	Yes	0	3	.999	.000 (.000)		
	No	16	83		1		
Delay in radiological inv.result	Yes	0	13	.944	.000 (.000)		
	No	16	73		1		
Poor prognosis	Yes	0	6	.999	.000 (.000)		
	No	16	80		1		
LAMA	Yes	0	2	.999	.000 (.000)		
	No	16	84		1		
CVD	Yes	7	22	.146*	2.263 (.753,6.798)	.522	1.579(.390,6.3)
	No	9	64		1		
Hematologic malignancy	Yes	1	20	.155*	.220(.027,1.770)	.132	.161(.015,1.73)
	No	15	66		1		
Endocrine	Yes	2	5	.343	2.314 (.408,13.122)		

	No	14	81		1		
Renal	Yes	2	7	.575	1.612 (.303,8.574)		
	No	14	79		1		
Respiratory	Yes	1	6	.916	.889 (.100,7.924)		
	No	15	80		1		
Other malignancy	Yes	0	3	.999	.000 (.000)		
	No	16	83		1		
Gastrointestinal disease	Yes	1	4	.792	1.357 (.141,13.061)		
	No	15	82		1		
CNS disease	Yes	1	3	.618	1.810 (.175,18.670)		
	No	15	83		1		

Crude odds ratio (COR) =*P<0.25; Adjusted odds ratio (AOR) =**P<0.05

6. DISCUSSION

This study tried to find out factors that affect ICU admission of critically ill patients and their length of stay in the ED. Emergency Department Length of stay is considered a key measure of emergency department throughput, and from the perspective of the patient, it is perceived as a measure of healthcare service quality, especially for those who need ICU care they don't have to spend more time in the ED. The society of critical care medicine (SOCCM) 2016, suggests the transfer time of critically ill patients from the ED to the ICU should be minimized or < 6 hours.

The result of the current study revealed that more than three fourth 86 (84.3%) of the critically ill patients stayed more than 6 hours in the ED, while 16 (15.7%) of them were transferred to the ICU in less than 6 hours of ED stay. This result implies that majority of patients who need ICU care; spending more hours in the ED and this was comparable to the same study done in Pakistan by Badar Afzal Khan, et al. (2010) in which 67.7% of them stayed in the ED for more than 6 hours before transferred to the ICU(22). The results were also consistent with a study of Menbeu Sultan, et al. (2016) who assessed 431 critically ill patients who need ICU admission from two tertiary hospitals in Addis Ababa, Ethiopia; the results reported that around 67.5% of the patients had delayed ICU admission (14), it shows that critical care service in Ethiopia is still need an improvement.

Research in Finland shows EDLOS of critically ill patients was short and from the total critically ill patients, 79.3% admitted to the ICU within 3 hours of ED admission (20), this result contradicted with the current study and highlighted that their health care system is much better than ours. In Pakistan observational study, it demonstrates the median emergency department LOS of a critically ill patients who need ICU care was 10.5 hours (22) and similar study conducted in Ontario, Canada showed the median EDLOS for all ICU admissions from ED was 7 (4-13)hours(24). In a previous study done on both TASH and St. Paulo's millennium medical college in 2016 which showed that the median EDLOS was 48 hours (14). In the present study, the median EDLOS was 13.5 hours, and this demonstrates still there is a prolonged emergency department length of stay of critically ill patients as the emergency time target < 6 hours. These result discrepancies may be the result of some improvement in the health sector, few governmental and nongovernmental health facilities launched.

High EDLOS may lead to increases ED overcrowding and may have an impact on the critically ill patient outcome, whereas certain organizational resource allocation and critical care service improvement may have a positive effect on it. Interdisciplinary methods can be utilized to investigate factors causing prolonged EDLOS and contribute better understanding of them.

Based on the data presented in this study, acute respiratory failure that requires ventilator support 26.5% was the common reason for need of ICU admission and septic shock was the second 18.6% followed by AKI and acute stroke each had 6.9% and CHF with respiratory failure 5.9%, but a study done in Ontario Canada and Pakistan showed cardiovascular disease is the most common cause of ICU admission (36% and 47.6% respectively) (22,24), this discrepancy may be due to the fact that cardiovascular disease is the leading cause of mortality especially in the developed countries. In the previous study done on both TASH and St. Paulo's and also in Finland trauma was the common reason for ICU admission (11.6% and 21.1% respectively) (14,20), which was not comparable from the current study. This may be due to after the previous study which was done in TASH and St. Paulo's other trauma centers were launched in the city.

In the current study among the total patients who need ICU admission 73.5% had known chronic medical illness and from the total 28.4% had cardiovascular disease and 20.6% had hematology malignancy. This study goes in line with a study done in Pakistan which showed most patients had a past medical history of cardiovascular disease and hematological malignancy (22). It simply indicated that patients who had these conditions need ICU admission more than others.

There are many major contributing factors for delayed ICU admission and in this study nearly half 56 (54.9%) of critically ill patients spent more than 6 hours due to lack of ICU bed followed by delayed in radiological investigation results 13 (12.7%) and poor prognosis, delayed laboratory investigation results, delayed in therapeutic procedures that can be done in the ED and LAMA was other reasons (6 (5.9%), 6 (5.9%), 3 (2.9%) and 2 (2.0%)) respectively. This study goes in line with a previous study done in TASH and St. Paulo's which revealed lack of ICU bed is the main reason for the prolonged ED stay(14). While studies on Finland and Pakistan showed diagnostic and therapeutic procedures that can be done in the ED and diagnostic group was the main reason for those who have delayed ICU admission (20,22), it shows their ICU bed capacity was better than ours.

This study indicates that critical care service is limited in the study hospital and other facilities like radiological service and laboratory service need improvement. Patients who had malignancy and those who had severe illness spent prolonged ED stay due to their poor prognosis and scarcity of critical care unit the physician prioritizes other patients.

The present study reveals critically ill patients who had co-morbidity have delayed ICU admission, but in multivariate analysis, it doesn't show any significant association. Male critically ill patients were less likely to transfer to the ICU within 6 hours of ED stay by 82% than females (AOR =0.175(0.044, 0.693)). This study is not comparable with the study done in Ontario, Canada, that shows no significant difference was found between male and female critically ill patients regarding delayed ICU admission (24). This may be possibly due to co-morbidity disease like cancer had high prevalence in males than females.

This study reveals that lack of ICU bed (AOR= 0.022, 95% CI: (0.002,0.201))has a significant association with delayed ICU admission and it shows that critically ill patients were less likely to transfer with less than 6 hours by 97% when there is lack of ICU bed. This contradicted with a study done in Finland, which performed radiological investigation was scored significantly higher than the other factors (20). These observations could be explained by the fact that scarcity of ICU bed is a problem of developing countries.

7. CONCLUSION

In conclusion, majority of the critically ill patients spend prolonged time in the ED at TASH despite requiring ICU admission. Lack of ICU bed, delays in radiological examination and laboratory investigation services were the most important factors which leads to delayed transfer to ICU. Also majority of critically ill patients need intensive care unit transfer due to acute respiratory failure that require ventilator support.

8. LIMITATIONS OF THE STUDY

As the study was based on only one institution, generalization as a whole was not considered. The study period was very short to study prospectively and data collection and analysis was very difficult. In addition, a cross-sectional study by its nature cannot establish a definitive cause and effect relationship to identify the risk factors. Also, the study did not assess the outcome of those critically ill patients who had delayed ICU admission due to short study period.

9. RECOMMENDATION

Recommendation for TASH managerial

Based on the findings of this study, TASH should plan to improve the critical care service by increasing the ICU capacity. Radiology and laboratory services are also the cause for the prolonged ED stay; many patients get these services in other diagnostic centers, so the hospital must improve it by allocating resources. Availability of ICU admission guideline should be mandatory to prioritize patients based on their illness severity.

Recommendation for further Research

More research is necessary to assess the outcome of prolonged ED stay of critically ill patients with regard to enhancing quality critical care.

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ANNEX 1: English version information sheet

Title: Assessment of factors affecting intensive care unit admission of critically ill patients from the adult emergency department in Tikur Anbesa Specialized Hospital, Addis Ababa city Ethiopia.

Principal investigator: Helen Teklie Tesfahun

Name of the institution: Department of Emergency Medicine, College of Health Sciences, Addis Ababa University.

Introduction of investigator

Greetings! My name is Helen Teklie. I am a master's student at Addis Ababa University School of Health Sciences, Department of Emergency medicine. Currently, I am researching on Factors affecting intensive care unit admission of critically ill patients from the adult emergency department in Tikur Anbesa Specialized Hospital, Addis Ababa. This information sheet is prepared to identify Factors affecting intensive care unit admission of critical patients from the adult ED, the study involves questioner that can be collected by the data collectors by reviewing the patient chart and follow the patient until he/she leaves the ED of TASH.

Purpose of study: The purpose of this research is to identify Factors affecting intensive care unit admission of critically ill patients from the adult emergency department in Tikur Anbesa Specialized Hospital.

Study procedure: By observation and the patient chart will be reviewed to assess the cause behind the delay admission of the intensive care unit. The findings of this study will be shared through the presentation, but the patient's name will not be mentioned in the report.

Possible risks/ discomforts: The study is not associated with any harm.

Possible benefits: At the moment, this study will not be of direct benefit to the study participant, but I hope that the findings from this study may help the policymakers to make decisions in allocating resources, strategies, and policies that will of advantage indirectly to you and to other patients who need admission to ICUs.

Data confidentiality: All collected data will be handled to protect confidentiality. No names will be mentioned and the information will be coded. I would like to assure you that all information about the patient will be protected from the public and personal identity will not be mentioned in any report of this study.

All details of information will be stored and secured with a password protected files in the researchers' personal computer.

Payment: There will be no payment for study participants since; the research is to be conducted while the participants are attending the Emergency Department.

Contact for additional information

If you need more clarification about this study, you can call or contact the researcher;

Helen Teklie *Mobile: 0924436126,*

Email: helutekle8@gmail.com

ANNEX 2: Hospital Consent Form

This study will be conducted at TASH in Addis Ababa city which is known to be the largest tertiary hospital. The main objective of this study is to identify factors affecting intensive care unit admission of critically ill patients from the adult emergency department from January to April, 2020. Studying the factors that delay ICU admission is useful to assess the quality of critical care service given. It also gives information for responsible bodies and hospital managers which could help to improve the service.

Delayed intensive care unit admission is a known exacerbating factor in ICU mortality. Ina developing country like Ethiopia, it is a common problem which leads to prolonged ED stay of a critical patient.

However, factors that delay ICU admission from the ED are not well documented in Ethiopia. Therefore, this hospital participation and collaboration is helpful in generating the required information and will be appreciated.

In this study the patients' medical records and an observation checklist will be used to collect necessary data prospectively. Any personal information of the patients like the name or others will not be collected and the information generated will be disclosed in totality. In addition, the confidentiality of any personal information will be maintained throughout the study process and it will not be allowed for unauthorized access to the information.

Finally, the hospital has all the right to accept or reject the study at any time. If there is any question or further information/elaboration is needed regarding the planned study and to get clarification from the principal investigator or from the institution, contact the principal investigator in person or use Telephone 0924436126 (Helen Teklie, principal investigator). Therefore, if you would like to decide the study will be conducted at this hospital, please confirm it by signing.

The participant hospital----------Principal investigator----------

ANNEX 3: Semi structured Questionnaire and Observational Checklist

MRN……

Part I: Socio-demographic Characteristics

101.	Age in Years	

102.	Sex	A) Male	
		B) Female	

103. Residence: 1. Addis Ababa 2.Oromia 3. Debub 4. Amhara 5.Other……

Part II: Baseline Information

201. Date of Admission to RED Zone ------/------/------ (DD/MM/YY) Time of admission…… (Day/night)

202. Source of Referral

1. Self4.Private Health Facility
2. Another Government Hospital
3. Public Health Center

5. Others (Specify)

Part III: Patient condition

301. Under which condition is the patient presented now?

1. Trauma
2. Non trauma

302. Is there any known Chronic Medical illness?

1. Yes (if yes specify)……
2. No
3. No record

303. Write the working diagnosis of the patient at RED admission?

- ……..

304. What are the treatment modalities given at ED? **(You can choose more than one)**

1. Ventilator support (noninvasive & invasive)
2. Endotracheal intubation
3. Initiation of Broad spectrum antibiotic
4. Initiation of Vasopressor
5. On monitoring
6. CPR
7. Others……

305. What is the level of Consciousness of a patient at the time of consultation? (Based on GCS)

1. GCS ≤ 8
2. GCS 9-12
3. GCS 13-15
4. Not evaluated/not recorded

306. How are the vital signs at consultation? **(Encircle it)**

1. RR: **a)** ≤ 8 **b)** 9-11**c)**12-20 **d)** 21-24**e)** ≥25
2. HR: **a)** ≤ 40 **b)** 41-50**c)** 51-90 **d)** 91-110**e)** 111-130**f)**≥ 131
3. Spo_2: **a)** ≤ 91% **b)** 92-93%**c)** 94-95%**d)** ≥ 96
4. Temp^{0}c : **a)** ≤ 35.0**b)**35.1-36.0**c)**36.1-38.0**d)**38.1-39.0**e)** ≥ 39.1^{0}c
5. SBP in mmhg: **a)** ≤ 90 **b)** 91-100 **c)**101-110 **d)** 111-219 **e)** ≥ 220
6. Supp. O_2 use **a)**yes **b)** no
7. Level of consciousness **a)** A **b)** V,P or U
   (A- alert, V-respond to voice, p-respond to pain, U-unresponsiveness)
8. Not recorded

307. Write the Date and Time of the consultation made to the ICU?

...../…….

308. What is the mode of communication used for the consultation?

1. Written consultation paper
2. Over the phone
3. Direct contact
4. Other……..

309. Write the date and Time of response from ICU?

……../ ……..

310. What is the decision of the ICU?

a) To admit

b) Not to admit, write the reason? .....

311. Is the patient transferred to the ICU?

a) Yes

b) No

312. If yes, write the time and date?

Date……/……/……. Time……..(Day/night)

313. Write the Length of stay in the ED before the patient transferring to the ICU…….. (**By hours**, from consultation to ICU transfer)

314. Is the patient wait in the ED for more than 6 hours after consultation?

a. Yes

b. No

315. If yes, choose the reason, why the patient waits in the ED after deciding to admit in the ICU (> 6 hrs.). **(You can choose more than one)**

1) Lack of ICU bed
2) Delay of laboratory diagnosis
3) Delay in therapeutic procedures that can be done in the ED
4) Delay in radiological services
5) Leave against medical advice/ refusal of treatment
6) Poor prognosis (physician decision)
7) Specify if other reason

…….

ANNEX 4: Assurance of Principal Investigator

The undersigned agrees to accept responsibility for the scientific, ethical and technical conduct of the research project and for the provision of required progress reports as Per terms and conditions of the Research Publications Office in effect at the time of Grant is forwarded as the result of this application.

Name of the student: Helen Teklie

Date_____ Signature _____

Approval of the primary Advisor

Name of the primary advisor: Dr. Hywet Engida

Date_____ Signature _____